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AGRICULTURAL MEMORANDUM NO 1005

ACCURACY OF TEMPERATURES MEASURED IN A SANDWICH SCREEN

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INTRODUCTION

In an attempt to identify fireblight susceptible varieties of cider apple during their period of bloom, several growers were asked to record temperatures and blossom data. To meet this requirement the Meteorological Department at ADAS Bristol Regional Office was tasked with designing and testing a suitable screen in which to house the thermometer. The specification called for:

a. The screens to be cheap in order to provide as many as possible within the budget.

b. The screens to be simple to construct because of limited workshop facilities at Long Ashton Research Station where they were to be made.

c. Temperatures to be accurate to $\pm$ 0.5°C at 18°C when compared with a conventionally mounted thermometer in a Stevenson screen.

Equipment and Methods

A 'sandwich' type of design was chosen which consisted of 4 horizontal, rectangular, 18 gauge alloy sheets separated by low conductivity spacers and hinged laterally for access. External surfaces were painted gloss white and internal surfaces matt black. The bottom plate was strengthened and rivetted to a square box section tube which was screwed to a 50 x 50 mm post 1.2m AGL. Thermometers were mounted asymetrically so that the bulbs were shaded from direct radiation when the sun was more than 5° above the horizon. A working drawing is shown in Figure 1. Comparisons were made of maximum and minimum temperatures in the prototype at Bristol by mounting it close to a standard large screen and taking readings from March to October.

RESULTS

The results corrected for instrumental error are summaried in Table 1.

TABLE 1 TEMPERATURE ERRORS

	Maximum	Minimum
Mean	0.21	- 0.05
Standard Deviation	0.30	0.23

Most of the readings were taken by inexperienced observers which will account for some of the variance and is probably responsible for the few large errors since no consistent pattern between error and temperature or synoptic situation could be found.

a. Maximum temperature

The mean error at 18°C is + 0.25°C and overall is + 0.21°C with a standard deviation of 0.30°C. However Figure 2 shows a trend for the error to increase with temperature and is probably due to the sandwich screen having a shorter response time and less effective radiation shielding. A linear regression of error (e) on maximum temperature (Tx) gives:

$$e = 0.042\ Tx - 0.51$$

and reduces the standard deviation of the residual to 0.15°C

b. Minimum temperature

A mean error of - 0.05°C with a standard deviation of 0.23°C shows no discernible trend and is within the calibration limits of the instruments.

TABLE 2

Size of Error	Percentage of readings with error Maximum	Maximum (about BFSL)	Minimum
0.0	12	22	22
0.1	20	29	26
0.2	21	20	25
0.3	16	12	12
0.4	10	8	9
0.5	8	3	4
>0.5	13	6	2

CONCLUSIONS

Smith (1951) found that standard deviations of differences between temperatures measured in adjacent but similar screens were about 0.2°C. The respective standard deviation of errors in this experiment of 0.30 and 0.23 for the maximum and minimum are therefore considered acceptable for dissimilar screens. When the linear trend of maximum temperature is removed and the few spurious points ignored the standard deviation falls to 0.15.

A sandwich screen similar to the one described here is capable of meeting its specification and is suitable for similar experimental work.

Any comments or suggestions on this paper should be sent to the Author.

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Figure 1

SANDWICH SCREEN

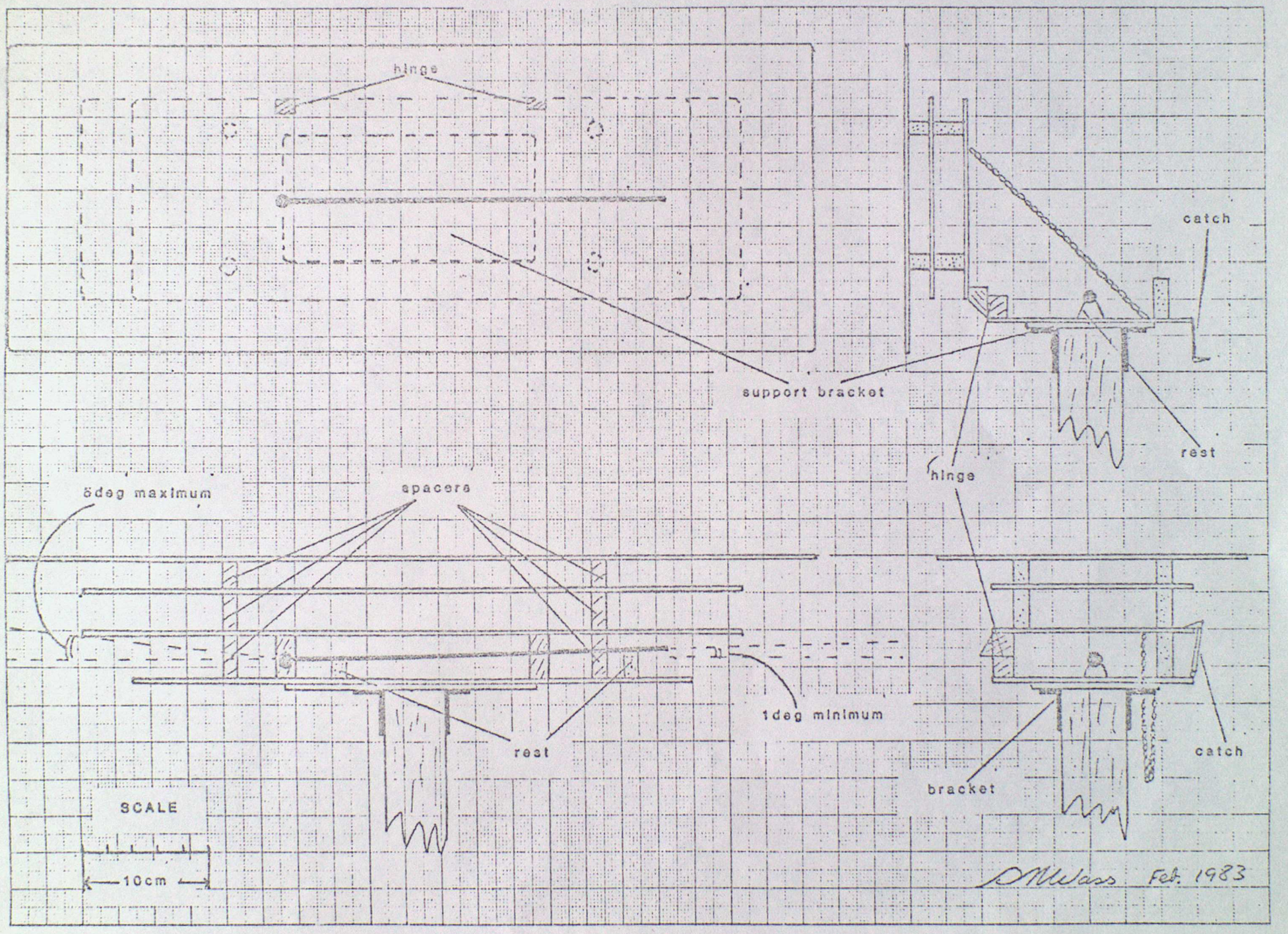

Figure 2. Errors in maximum temperature